

The Impact of Online Streaming on Primetime Viewership  
An Econometric Analysis of Technological Change, Network Practices  
and Audience Behavior

Yeshwanth R. Kandimalla

*Professor Michael Munger, Primary Advisor*  
*Professor Michelle Connolly, Secondary Advisor*

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## ABSTRACT

This study considers the impact of online streaming on the viewership of popular primetime programs aired on four major U.S broadcast networks: ABC, CBS, FOX and NBC. The time period considered will begin with the 2004-2005 TV season through the 2011-2012 season. Technological change, primarily with faster Internet speeds, spurred some growth of online video streaming. Furthermore, over this time period, the four major networks all authorized streaming at different levels. This variation in availability provides the heterogeneity needed to compare the effect of making programs available online. The existing literature has posited two effects of online streaming: substitution away from traditional TV viewing due to lower costs or complementarity by drawing in additional viewers. Using this framework, this study conducts an empirical analysis of TV viewership and online availability with a panel of more than 3,500 episodes across 8 seasons and 42 programs. The results strongly suggest that online streaming options drive statistically significant substitution away from traditional TV viewing, a trend that can have major consequences for the distribution of TV programs and the broadcast TV business as a whole.

JEL Classification: L82, D12, D22

Keywords: online streaming, networks, Big Four, Hulu, FOX, network television, cable, cord-cutting

## **Introduction**

The growth of online streaming through legal channels such as Hulu and Netflix, as well as illegal websites, has fundamentally altered the TV viewing experience. This study aims to determine the extent to which online streaming has affected viewership for the Big Four broadcast networks (ABC, CBS, Fox and NBC) for their popular primetime programs. The data and methods therefore consider how weekly viewership of primetime shows on ABC, CBS, Fox and NBC has responded due to online streaming over a time frame spanning the 2004-2005 broadcast season through the 2011-2012 broadcast season. From a microeconomic standpoint, I aim to examine the substitutability and/or complementarity of online streaming and other forces for TV consumers. I hypothesize that the substitution effect will dominate with a statistically significant magnitude, meaning that online streaming will significantly reduce viewership of primetime broadcasts.

If the dominant substitution effect is true across the board for the four major networks, it could redefine the meaning of primetime, considered to be 8 p.m. to 11 p.m. Sunday through Friday, for the Big Four and fundamentally alter the way that these networks allocate their airtime, disseminate programs and generate revenue. For example, the major networks currently air programs during their television slot before delaying authorized online video until the next day. Over time, if consumer preferences shift significantly toward online consumption of TV shows, then the Big Four may have to drop the delay model and simulcast programs online. This shift is just one of many that could occur if online streaming supplants sitting in front of a TV with cable service.

A shift in consumer preferences could also have major implications for the ad-supported revenue model for the Big Four networks and the audience measurement tools

they use. Traditionally, broadcast television supplied a two-sided market, one with content demanded by viewers and another with audiences demanded by advertisers. The networks did not directly charge viewers a subscription fees, but relied almost exclusively on revenue from advertisers (Napoli, 2004, pp.16-17). In an uncertain advertising market, networks are compensating by increasing carrier or affiliate fees, leading to public fights between networks and cable providers (Stelter, 2009). Networks often have more leverage in these conflicts because they control the content people enjoy. Time Warner Cable lost 30 percent of its subscribers after CBS initiated a blackout over contested carriage fees (Stock, Bloomberg, 2013). Recent quarterly data from several TV companies points an increase in revenues from fees occurring simultaneously with a dip in advertising revenue (Sharma, WSJ, 2013). However, content providers cannot simply switch to carriage fees in the face of declining audience, when those fees, like advertising, are linked to a large, measurable, and sustainable audience.

### **Literature Review**

Broadly speaking, empirical research on this topic is very limited because the online streaming of television shows emerged primarily in last eight years. It is worth laying out a basic timeline of changes in online streaming. YouTube, which was later purchased by Google, launched in February 2005 and jumped to become one of the most popular websites within 18 months (Waldfoegel, 2009). YouTube, known for hosting thousands of video clips posted by users, is now the third most popular site, according to traffic rankings by Alexa, a web analytics company. The introduction of YouTube, which often featured unauthorized clips from copyrighted content, elicited divergent responses from the major networks. Copyright owners moved to protect their intellectual property: Viacom, now CBS corporation, sued Google for \$1 billion in March 2007, arguing that

YouTube hosted over 100,000 clips that represented lost revenue for the media conglomerate (Waldfogel, 2009). The lawsuit was ultimately settled confidentially in March 2014. Company insiders said, albeit anonymously, that no money was exchanged (Stelter, CNN, 2014).

However, networks responded proactively by streaming some programs. In late 2005, networks began experimenting with online streaming. This coincided approximately with NBC and CBS' decisions to offer low-priced downloads of previously aired episodes through Apple iTunes and Google Video, respectively (Waldfogel, 2009). By the 2006-2007 season, all four major networks began streaming full episodes of a portion of their primetime lineup on their respective websites (i.e. cbs.com, nbc.com, abc.com), but the streaming was delayed until the next morning after the original broadcast time, a practice that continues today (Waldfogel, 2009). FOX and NBC launched Hulu, a website to stream their programs, as a joint venture in March 2008 (Ulin, 17). As a joint platform, Hulu allowed the distributors to more easily achieve economies of scale while directing their audiences to a single access point (Ulin, 18).

The general sequence<sup>1</sup> of television broadcasts moving from their regular timeslot to authorized secondary platforms follows below:

**TV Broadcast → Residential video on demand or pay per view → Internet re-broadcast (streamed online) → Video release → Downloads → Syndication**

The networks retain the first broadcast rights on the show, but the model has come under fire. Many cable providers who pay syndication fees for reruns would, and have, argue that they should not pay fees when content owners are authorizing streaming free of charge over the Internet (Ulin, 43). More broadly, online streaming fundamentally

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<sup>1</sup> As outlined by media executive Jeff Ulin (2010) on page 43.

undermines traditional television by eliminating the requirement to have a TV or the constraint to tune in at a pre-defined time. Networks lose the benefits of a primetime lineup, where a popular lead-in can boost the audience for a later broadcast. By compartmentalizing the viewing experience, online streaming should appeal more broadly to Internet users and drive substitution away from television viewing.

Joel Waldfogel's empirical research, however, suggests an alternate picture. He surveyed 287 students at the University of Pennsylvania in May 2007, a group with a median age of 20. Nearly all reported actively using the Internet and keeping up to date with new developments in online streaming (Waldfogel, 2009). The survey responses, categorized as traditional television, authorized sites (nbc.com, cbs.com) and unauthorized sites (youtube.com, tv-links.co.uk), indicated that YouTube was by far the most popular website. Time spent viewing television declined almost 20 percent between 2005-2006 and 2006-2007, and this mirrored an increase in the use of authorized sites, which began streaming around that timeframe (Waldfogel, 2009).

The results, derived from cross-sectional and longitudinal regressions, suggest that although there was a decline in viewing traditional television, online streaming increased the total amount of time spent viewing TV programs, regardless of platform. This pattern can intuitively make sense: With episodes available online, audiences could miss all or part of the TV broadcast but catch up later. As such, Waldfogel found that overall TV audiences grew, even though viewership of traditional TV declined slightly over two seasons. The growth of authorized streaming by networks further suggests that preferences have shifted in favor of online viewing, because authorized sites generally offer better video quality (Waldfogel, 2009). In his conclusion, Waldfogel encouraged

networks to pursue online streaming to increase their audience, though he noted that online advertising revenue might not match that of conventional TV.

Although Waldfogel's research provides meaningful insight into new developments in entertainment, Internet access and delivery has evolved rapidly since his data were collected in May 2007. With each passing year, his findings likely become less relevant. The explosion of broadband Internet access and smartphones should lead to increased time spent viewing television online, per his survey. Assuming aggregate audience numbers across all platforms continually increased, we should observe a marked decline in traditional TV viewership. More recent research should examine whether that has in fact occurred. He also acknowledged that Penn respondents are not a representative sample of the American TV-viewing population. The limitations invite research that uses broader Nielsen data to measure viewership and considers a longer timeframe.

### **Theoretical Framework**

#### *Substitution from Traditional TV to Online Streaming*

Fundamentally, the research questions relate the broader area of consumer preferences between traditional media (radio, print, television) and online media. Rapid technological advances often shape consumer preferences between traditional and online distribution. There are theoretical foundations supporting both the substitutability and complementarity of online TV distribution for traditional broadcasting.

In television, both distribution platforms deliver similar content. The same TV shows, in terms of plot, characters and other substantive elements, are published online, so audiences, in theory, derive roughly equivalent utility in terms of entertainment, regardless of the platform. The real difference may arise in terms of cost, because online streaming requires less in both transaction and opportunity costs. For basic transaction



costs, the costs associated with buying and maintaining a television unit and services likely exceed that of paying for an Internet connection. To that point, in a recent consumer survey, nearly 23 percent of people who stream online cited “Don’t have pay TV service” as their top reason for watching online video.<sup>2</sup>

Absent lower transaction costs, the greater convenience offered by online TV streaming can also present lower opportunity costs. Viewers can gain a more compartmentalized experience from TV shows streamed online. On-demand online content all but eliminates the need to schedule time in front of a TV set and allows viewers to watch older episodes. In the same survey mentioned above, other popular motivations for streaming TV online included watching a program at one’s convenience, catch a missed episode, or watching previously aired episodes to get into a program.<sup>3</sup>

People streaming online also reported spending about one third as much time watching advertisements compared to those watching traditional TV.<sup>4</sup> This gap stems from the varied and diffuse nature of online advertising, which can include banner ads, search engine ads and video ads. The online advertising model offers numerous points of exposure to consumers and thus increases the supply in the advertising market (Evans, 2008). Authorized distributors of TV programs fight for audience attention with many other websites and search engines, and the increase in supply has made the entire ad market more competitive (Evans, 2008).

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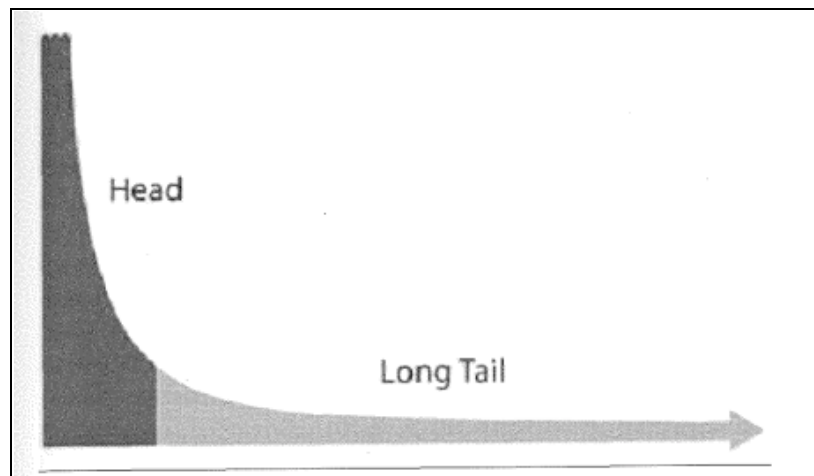
<sup>2</sup> “45 million reasons and counting to check out the new fronts.” GFK Media and Entertainment Survey, April 2013.

<sup>3</sup> Ibid.

<sup>4</sup> Online Video: A Statistical Review, Dan Piech, Comscore, Feb. 5, 2013. Slide 23

*Audience Distribution and the Long-Tail Phenomenon*

However, far more than providing an additional distribution platform for TV shows, the Internet has brought on a plethora of other entertainment options, including gaming, user-generated videos, social media, etc. to occupy people's time. The greater number of options and access points through computers, mobile phones and other devices has contributed to media fragmentation. This, in turn, leads to audience fragmentation: The attention of the audience becomes more dispersed across different media, described and visualized by economist Philip Napoli (2011) as the "long-tail phenomenon" (p. 67).



Essentially, audiences gravitate to a few hits, but when presented with the greater entertainment options, the tail of audience distribution becomes longer and thicker (Napoli, 57). Audience fragmentation occurred in tandem with media fragmentation before the growth of the Internet. The greater number of TV channels or radio stations meant that the top of the distribution (i.e. the hit programs) would shift down and the tail of the graph would become longer. The advent and growth of the Internet accelerated this media fragmentation. The thickening would occur in the tail if access to the alternate options increases (Napoli, 58).

Alternatively, greater access could draw more viewers for the hit, making the head of the audience distribution even more pronounced. Complementarity could occur, especially with a wider audience drawn to an already popular show. This complementary effect will likely not overcome the lower costs of online streaming, leading to my hypothesis that substitution will dominate.

### **Empirical Specification**

A model to test the hypothesis should account for the longitudinal nature of the data with technological change. In order to keep data collection and cleanup manageable, certain traits of shows, such as critics' reviews and timeslots, would likely not be observed.

With these considerations, a fixed effects or random effects estimator would be appropriate, given that it is a panel data set from 2004-2005 through 2011-2012. The following is the regression equation with all observed variables included:

$$\begin{aligned} \text{Viewers} = & \beta_0 + \beta_1 (\text{online availability score}) + \beta_2 (\text{score})^2 + \beta_3 (\text{contest}) + \beta_4 (\text{contest}) \\ & \times (\text{score}) + \beta_5 (\text{scripted}) + \beta_6 (\text{scripted}) \times (\text{score}) + \beta_7 (\text{Netflix}) + \beta_8 (\text{age of show}) \\ & + \beta_9 (\text{age})^2 + \beta_{10} (\text{broadband subscriptions}) + \beta_{11} (\text{strike}) + \alpha_i + \nu_{it} \end{aligned}$$

The dependent variable in the regression, *viewers older than age 2 per episode*, should decrease over time, assuming a dominant substitution effect away from traditional TV. The explanatory variables are the *online availability score* assigned to the show based on its network's streaming practices; a *contest* dummy assigned to reality shows that are competitive in nature (American Idol, for example); a *scripted* dummy for shows with a script and actors; and a *Netflix* dummy assigned to shows whose concluded seasons were available to stream on Netflix.com.

The *online availability score* will vary depending on where the show is authorized to stream. The heterogeneity in the data primarily comes from the different levels of availability of each program. For the 2004-2005 season, the online availability scores<sup>5</sup> for all episodes equal 0, because none of the Big Four authorized streaming of episodes, and unauthorized streaming was muted. For 2005-2006, all programs are assigned a base availability score of 1, because the rapid growth of YouTube and other user-generated video websites promoted unauthorized streaming (Waldfogel, 2009). From 2006-2007 onward, when authorized streaming gradually became implemented, shows that were authorized to stream on the network websites (abc.com, nbc.com, cbs.com, fox.com) were assigned a score of 2.

In March 2008, NBC and FOX jointly launched Hulu.<sup>6</sup> Thus, from 2008-2009 onward, nearly all FOX and NBC shows were assigned a score of 2, a point increase due to their additional placement on Hulu. ABC joined Hulu as a partner in 2009,<sup>7</sup> so its primetime programs were assigned a score of 3 from 2009-2010. CBS, arguably the most conservative of the Big Four when it comes to online distribution, has still not published its current programs on Hulu, so all of its programs remain with a score of 2.

The score is computed on a linear scale, but the squared term will factor declining marginal returns of increased online distribution.

The *contest* dummy considers whether competitive reality shows, such as “Survivor” and “American Idol,” draw more traditional TV viewers because they offer an element of uncertainty. They would, in theory, be less appealing to watch on the web

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<sup>5</sup> Ideally, I would also have the online unique visitors per episode, the web analog of TV viewers, but measurement companies do not offer that level of granularity for much of the period studied.

<sup>6</sup> [http://www.hulu.com/press/launch\\_press\\_release.html](http://www.hulu.com/press/launch_press_release.html)

<sup>7</sup> [http://www.hulu.com/press/disney\\_press\\_release.html](http://www.hulu.com/press/disney_press_release.html)

after the TV airing. The interaction term with the online availability score will help evaluate this claim. Conversely, the *scripted* dummy would address the idea that viewers have less incentive to watch a scripted show on its first broadcast, and are willing to wait for the episode to be published online. The *Netflix* dummy will examine the effect of prior seasons being available on Netflix. Theoretically, it could draw audiences to TV, suggesting a positive coefficient, but it could also lead to overexposure of a program and make cable subscriptions less appealing.

Three control variables are included:

*Age of show*, determined by number of seasons aired, will factor in an established show's popularity relative to a newer show trying to build an audience. The squared term considers decreasing marginal utility for an audience, as the show gets older.

*Broadband subscriptions*, determined by the Federal Communications Commission, counts the number of fixed and mobile Internet subscriptions for broadband Internet. It will proxy increased Internet usage over time, especially for leisure.

The *strike dummy* accounts for the impact of the Writers' Guild of America strike, which interrupted production and airing of many network TV programs. TV shows, typically scripted, non-reality programs, whose broadcast schedules were interrupted by the strike were assigned a value of 1 for the dummy.

### ***Unobserved Variables***

This equation does not specify certain variables that may have an impact on the dependent variables in general. Two particular phenomena, digital video recording and original programming on basic cable (TNT, TBS, Discovery, etc.) and premium cable (HBO, etc.) are not explicitly controlled. For the former, there was a lack of reliable, non-proprietary data on DVR viewership covering the entire 8 seasons studied. A program-

level fixed effect should control for the factors that influence DVR viewership, such as timeslot and appeal to certain demographics. Furthermore, while DVR time-shifts TV viewing, it still qualifies as traditional TV viewing facilitated by a cable subscription. DVR also does not meaningfully reduce live viewership per episode, but instead draws viewers for niche programs outside primetime (Zigmond et. al, 2009).

For the latter, there is a lack of viewership numbers or other reliable proxies for the popularity cable TV programs. Although, by some measure, the broadcast viewership share is decreasing while that of basic cable is increasing, this trend was apparent well before the growth of online streaming.<sup>8</sup> Furthermore I find that, while basic cable may be growing in the aggregate, individual programs do not match network shows in viewers and often air on different schedules from broadcast programs. While future studies should investigate or control for the impact of these phenomena, the variables specified for this paper are sufficient to answer the original research question regarding online streaming.

## **Data Collection and Adjustment**

### **Viewership**

My viewership data comes from SpottedRatings.com, a website run by Ed Bowman, a TV ratings enthusiast who posts weekly updates on the ratings for the Big Four networks. He primarily sources his data from TVBytheNumbers.com and FutonCritic.com, two popular websites specializing in media news. Having crosschecked with those websites and verified many key data points, I am confident as to its accuracy.

He maintains a historic ‘vault’ section on the website that compiles viewership data dating back to 2004-2005, the first period in my panel. I first take episode-level viewership data for 22 programs per season, which yields about 400-500 observations per

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<sup>8</sup> <http://tvbythenumbers.zap2it.com/2010/04/12/where-did-the-primetime-broadcast-tv-audience-go/47976/>

season. The viewership data are Live + Same Day, meaning those who watched in the regular timeslot plus those who watched on DVR before 3 a.m. the following day.<sup>9</sup> These 22 programs are among the top-third of primetime programs in terms of popularity.

Admittedly, the data are constrained by the thoroughness of Bowman's data collection, yielding a somewhat unbalanced panel.<sup>10</sup> I have to limit my sample to the most popular programs because the website consistently has data only for them dating back to 2004. However, marginal programs in the middle or bottom tier of popularity could arguably be more affected by online availability, but I am unable to consider these given the limitation of the available data. A deeper study could analyze the impact of online availability based on the show's initial rank in viewers.

The raw data from Spotted Ratings are then adjusted to a per-capita measure, viewers per 100,000 people. The per-capita measure is necessary to control for Nielsen's changing estimate of the total number of people older than 2 living in households with a TV. The table below shows some statistics after adjusting the data.

Season	Total TV Population	Median Viewers per 100K	Mean Viewers per 100K	Observations
2004-2005	278,367,347	6,155	6,273	371
2005-2006 (YouTube grows)	280,810,811	5,881	6,169	434
2006-2007 (Networks begin streaming online)	283,333,333	5,634	5,898	438
2007-2008 (Writer's strike)	285,148,515	4,884	5,211	420

<sup>9</sup> <http://www.spottedratings.com/2010/10/breaking-down-live-same-day.html>

<sup>10</sup> The nature of TV programs, which may come on and go off the air depending on the season, also meant the panel would inevitably be unbalanced.

2008-2009 (NBC, FOX launch Hulu)	290,978,260	4,851	4,964	452
2009-2010 (ABC joins Hulu)	292,040,000	4,455	4,583	440
2010-2011	294,650,000	4,089	4,479	458
2011-2012	289,700,000	3,973	4,146	502

### Online Availability Score

This information<sup>11</sup> is primarily sourced from popular media, such as newspapers, trade publications and press releases.<sup>12</sup> Waldfogel also specifies the small number of network shows were available through the 2006-2007 season, the latest one he considered. The table below reviews the scoring grid per show:

Level of Availability	Score
Not available on the Internet (generally 2004-2005, pre-YouTube)	0
Available somewhere on the Internet (Unauthorized included)	1
Available for free on the network website (i.e. cbs.com, fox.com, etc.)	2
Available for free on the network website and another website (essentially Hulu)	3

### Scripted Dummy

The scripted dummy applies to all episodes with actors and professional screenwriters. This identifies to all sitcoms, dramas, police procedurals, etc.

### Contest Dummy

<sup>11</sup> In the research process, I tried to find actual web traffic per individual episode, but there are few data with this granularity during this period.

<sup>12</sup> The WebArchiver was not useful because it had a limited range of screenshots of a webpage, and it didn't have screenshots of the relevant URL to determine whether a show was on the website.



The contest dummy applies to all reality competition shows. The most common ones in the data are FOX's American Idol and The X Factor, CBS' Survivor, ABC's Dancing with the Stars and The Bachelor, and NBC's Biggest Loser and The Voice. Spotted Ratings does not have data for regular sportscasts like Monday Night Football. Of the 3,535 episodes observed in the data, only 130 (less than 5 percent) are neither scripted nor contest episodes. These episodes pertain to only two programs (Extreme Makeover: Home Edition and Undercover Boss), both non-contest reality shows.

### **Netflix Dummy**

Again, this is primarily sourced from popular media. As a general timeline, NBC and ABC made deals with Netflix starting in 2009-2010 to stream a few popular shows, including The Office and Law and Order SVU (NBC)<sup>13</sup> and Desperate Housewives and Grey's Anatomy (ABC).<sup>14</sup> Netflix added FOX programs such as Glee and Family Guy beginning in 2010-2011.<sup>15</sup> CBS, again the most conservative of the Big Four, primarily put shows that are off-the-air on Netflix. The only CBS program added to Netflix while still on the air was "How I Met Your Mother," starting in 2011-2012. The program interestingly saw a 20 percent boost in its viewership during that season.<sup>16</sup>

Approximately 8 percent of the observations are episodes of shows with prior seasons on Netflix. All of these shows are scripted.

### **Age of Show**

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<sup>13</sup> <http://www.prnewswire.com/news-releases/netflix-and-nbc-universal-announce-agreement-to-stream-prior-season-cable-and-broadcast-tv-series-new-to-netflix-members-103694809.html>

<sup>14</sup> <http://gigaom.com/2009/08/03/netflix-starts-streaming-abc-shows/>

<sup>15</sup> <http://www.prnewswire.com/news-releases/twentieth-century-fox-and-netflix-announce-comprehensive-strategic-agreement-that-includes-physical-and-digital-distribution-90333649.html>

<sup>16</sup> [http://www.nytimes.com/2012/04/09/arts/television/cbss-how-i-met-your-mother-late-blooming-hit.html?\\_r=2&pagewanted=2&](http://www.nytimes.com/2012/04/09/arts/television/cbss-how-i-met-your-mother-late-blooming-hit.html?_r=2&pagewanted=2&)

This is basic information that can found on imdb.com (Internet Movie Database). It is a whole number (1 for first season, 2 for second season, etc.).

### **Broadband Subscriptions**

The FCC compiles data biannually (June and December) from filings by Internet service providers on Form 477 to determine the number of broadband Internet subscriptions in the United States. The FCC has not been consistent in the way it reports the number of connections by transfer speed, but the table below outlines the total fixed and mobile subscriptions per 100,000 people. I adjusted the data to per-capita based on the Census Bureau's population estimate for the respective year and month. The speed threshold per period is shown below. The FCC did not break down connections by transfer speed before June 2005. The speed tier (200 kilobits per second minimum in at least one direction) is quite slow, but the FCC changed its definition of high-speed Internet and therefore does not break down speed tiers consistently in each report.

Year	Subscriptions	Per 100,000
June 2005	42,517,810	14,388
Dec 2005	50,930,245	17,148
June 2006	64,991,653	21,780
Dec 2006	82,525,450	27,508
June 2007	100,986,136	33,528
Dec 2007	121,222,347	40,047
June 2008	132,813,984	43,674
Dec 2008	102,239,000	33,466
June 2009	119,433,000	38,929
Dec 2009	136,294,000	44,223
June 2010	157,017,000	50,765
Dec 2010	182,065,000	58,636
June 2011	206,131,000	66,152
Dec 2011	230,387,000	73,653
June 2012	243,397,000	77,540

The observations are obviously much less frequent than those for the viewership data. I assigned a broadband subscription rate to an episode based on the forward number. For

example, if an episode aired in October 2011, I assigned it the December 2011 number. If a later episode aired in March 2012, I assigned it the June 2012 number.

### **Strike Dummy**

The WGA strike lasted from November 2007 to February 2008. Depending on when its episodes were written, certain scripted programs were affected. After looking through Wikipedia and cross-referencing news articles, I assigned 1 to episodes of programs whose 2007-2008 seasons was interrupted by the writer's strike. About 8 percent of episode in the sample are from shows, all scripted programs, whose schedules were interrupted by the strike.

## Results

**Table 1**

Variables	(1) FE Viewers (thousands)	(2) RE Viewers	(3) FE Viewers	(4) RE Viewers
Online availability score	-559.4*** (40.65)	<b>-541.4***</b> <b>(38.57)</b>	<b>-124.8</b> <b>(79.02)</b>	-101.4 (77.96)
Score <sup>2</sup>			<b>-141.5***</b> <b>(22.11)</b>	<b>-142.2***</b> <b>(22.08)</b>
Netflix	-609.0*** (85.16)	<b>-622.5***</b> <b>(84.66)</b>	<b>-451.8***</b> <b>(88.16)</b>	<b>-466.6***</b> <b>(87.66)</b>
Age of show	122.2*** (34.35)	<b>101.4***</b> <b>(30.23)</b>	<b>116.5***</b> <b>(34.17)</b>	92.54*** (29.64)
Age <sup>2</sup>	-5.092*** (0.902)	<b>-4.801***</b> <b>(0.863)</b>	<b>-4.847***</b> <b>(0.897)</b>	<b>-4.510***</b> <b>(0.855)</b>
Broadband	-0.0147*** (0.00286)	<b>-0.0131***</b> <b>(0.00258)</b>	<b>-0.0148***</b> <b>(0.00284)</b>	<b>-0.0130***</b> <b>(0.00254)</b>
Strike	-278.5*** (68.39)	<b>-286.8***</b> <b>(68.08)</b>	<b>-349.4***</b> <b>(68.90)</b>	<b>-359.4***</b> <b>(68.62)</b>
Constant	6,382*** (64.78)	<b>5,864***</b> <b>(231.5)</b>	<b>6,200***</b> <b>(70.37)</b>	5,691*** (217.5)
Observations	3,535	<b>3,535</b>	<b>3,535</b>	3,535
R-squared	0.299	<b>0.299</b>	<b>0.307</b>	0.307
Number of programs	42	<b>42</b>	<b>42</b>	42

Standard errors in parentheses  
 \*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1

These regression coefficients illustrate the increasingly negative relationship between online availability and viewers. The inclusion of the squared term reinforces a

dominant substitution effect away from traditional TV. Given that the dependent variable (viewers) is scaled in thousands, the coefficients indicate that online availability has a depressing effect on viewers per capita by the hundreds. The absolute value of the score and score<sup>2</sup> coefficients exceeds both the linear and squared terms for age of show. Netflix availability also had a negative effect, suggesting that having prior seasons on the site means overexposure. The Hausman test, when conducted for the first two estimations, yields a failure to reject the null. Therefore, the random effects estimation (column 2) is the more efficient estimator. Conversely, for the second pair of estimations, the Hausman test yielded a rejection of the null, indicating the fixed effects were unbiased and therefore the better test for the hypothesis.

The R-squared term consistently approaches 0.3 across all four models. Given the limitations of data collection, there are many unobserved variables, such as critics' reviews, marketing expenditures for particular programs, time slot and narrower demographics (i.e. younger or wealthier audiences) of viewership. Explaining 30 percent of the variation with 6 to 7 variables seems satisfactory at a minimum.

However, one major concern arises. First, as mentioned earlier, the Netflix and strike dummies refer only to scripted shows. They could likely be capturing an effect of program being scripted. Thus, the contest and scripted dummies should be incorporated, but since they are time-invariant, they can only be incorporated in a random effects model.

**Table 2**

VARIABLES	(1) Viewers	(2) Viewers	(3) Viewers
Online availability score	-101.8	-96.16	-961.8***

	(93.73)	(78.53)	(220.3)
Score <sup>2</sup>	-142.2***	-148.4***	-166.0***
	(22.75)	(23.04)	(23.37)
Netflix	-465.6***	-439.0***	-442.0***
	(92.01)	(92.15)	(91.95)
Scripted	64.23		-1,777*
	(450.3)		(965.0)
Scripted x score	-0.999		928.1***
	(48.30)		(221.0)
Contest		-139.6	-1,892*
		(471.9)	(1,012)
Contest x score		47.35	971.9***
		(49.40)	(225.8)
Age of show	93.83***	89.52***	88.40***
	(30.36)	(30.67)	(30.89)
Age <sup>2</sup>	-4.532***	-4.637***	-4.747***
	(0.865)	(0.868)	(0.869)
Broadband	-0.0131***	-0.0126***	-0.0121***
	(0.00259)	(0.00262)	(0.00264)
Strike	-359.1***	-364.1***	-377.1***
	(68.78)	(68.84)	(68.77)
Constant	5,651***	5,731***	7,449***
	(357.7)	(264.9)	(922.6)
Observations	3,535	3,535	3,535
R-squared	.3067	.3068	.3105
Number of programs	42	42	42

Standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

The scripted and contest dummies are almost perfectly multicollinear, as noted. The effect is apparent in the output found in the third column of Table 2. The dummies and respective interaction terms are large and positive in magnitude, and highly statistically significant. However, the linear term for online availability score also soars in absolute value and statistical significance, suggesting that it may be confounding the coefficients of the contest and scripted terms.

When scripted and contest variables are treated as perfectly multicollinear and not included simultaneously, as in columns 1 and 2 of Table 2, the coefficients are much more in line with previous estimations. The contest and scripted dummies are not statistically significant or large on any meaningful level. These outcomes suggest negligible empirical justification for the idea that programs with a competitive element might see less substitution toward online viewing.

**Table 3**

VARIABLES	(1) FE Viewers	(2) RE Viewers
Unauthorized	<b>-210.7***</b> (66.25)	-194.0*** (65.58)
Network site	<b>-668.6***</b> (68.45)	-624.3*** (65.41)
Hulu	<b>-741.8***</b> (72.22)	-734.4*** (71.40)
Netflix	<b>-489.4***</b> (89.82)	-499.6*** (89.48)
Age	<b>131.7***</b> (34.87)	101.2*** (29.98)
Age squared	<b>-5.020***</b> (0.901)	-4.592*** (0.856)
Broadband	<b>-0.0155***</b> (0.00286)	-0.0133*** (0.00254)
Strike	<b>-360.5***</b> (69.06)	-370.0*** (68.84)
Constant	<b>6,146***</b> (74.60)	5,656*** (216.9)
Observations	<b>3,535</b>	3,535
R-squared	<b>0.308</b>	0.308
Number of programs	<b>42</b>	42

Standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Still, the coefficients on the squared term support the idea that increasing online availability accelerates a decrease in traditional TV viewers. To assess this finding in a different way, I created three new dummy variables—*authorized*, *networksite* and *hulu*—

to correspond with the respective scores (score 0 equals zero for all three dummies, score 1 means unauthorized equals 1, etc.). The regression results with these modified online availability variables are summarized in Table 3. The increasingly negative relationship and substitution are also reflected in the coefficients of these dummy variables. The large negative Hulu coefficient suggests that creating a central point to aggregate and present videos has predictably heightened substitution away from traditional TV.

### **Conclusion**

Waldfoegel conducted his research in the very early years of online streaming. At the time, there was much more uncertainty as to how audiences would respond and potentially supplement, or completely upend, the traditional television business. Five years later, with dramatic growth in Internet access and quality of web programming, there is clear movement away from sitting in front of a TV to watch a show at 9 p.m. when that same program could be available soon after, with little to no advertising, on a computer or mobile device. Trends described in the business media support this notion: There are “cord-cutters” who have canceled their cable TV subscriptions (Centris, 2014) as well as “cord-nevers,” (King, 2013) younger people who are so accustomed to getting their TV online that they do not ever have a subscription to cancel. In absolute numbers, cord cutters are still relatively minimal compared to the total number of subscribers (King, 2013), but the trend, especially in its skew toward younger consumers, has major implications for production and distribution model for TV programs.

Waldfoegel, in evaluating the behavior of his young, technologically savvy sample, postulated that online streaming is a prudent business strategy because it increases the total time spent watching and engaging with TV programs. Judging by the broadcast networks’ actions in recent years, online streaming has not played out that well as a



business strategy. In July 2012, an internal memo among the partner networks outlined recommendations to change content-sharing agreements and limit the availability of programs on Hulu (Wallenstein, 2012). Networks have created more obstacles to cord cutting. FOX began requiring online viewers to authenticate a paid cable subscription to specific group of providers, as part of the agreement known as ‘TV Everywhere’ (Stelter, 2011). Under the scheme, only authenticated users would have access to an episode on Hulu or fox.com the day after airing. Other users would have to wait 8 days. ABC implemented similar restrictions beginning January 2014 (Spangler, 2013).

These trends raise complex questions about the future of television programming and distribution. Networks may legitimately fear a trajectory similar to print media, which, with the advent of the Internet, has a growing audience but declining revenues. Various measures, such as TV Everywhere, increased cable and affiliate fees, clearly point to an effort to maintain ground in a slowly eroding model. Some aspects of the online shift have beyond the control of networks, and online streaming, authorized or not, has now become a basic expectation for many, if not most, Internet users. TV networks still need profitable business models to continue producing content that many people want without actually watching TV. For one, these findings reinforce the importance of audience measurement that truly reflects the array of access points for a program. Nielsen will begin measuring episode-level viewership on mobile devices and tablets and incorporating them into the ratings it assigns to programs (Spangler, 2013). This is a positive step, but an accurately gauged online audience does not necessarily translate to proportionate increase in revenue. Substitution away from traditional TV viewing, if occurring exponentially over time, should prompt networks to find ways to more creatively leverage and monetize their online audience.

Some limitations come with these findings. As mentioned earlier, certain variables are not explicitly specified or observed, due to limited data. The inferences are most applicable to the most prominent networks and programs. Further study on this topic could delve into the effects of streaming on more niche TV programming or consider the impact of restrictive measures, like authentication, on viewership. Nonetheless, the findings illustrate a meaningful transformation in the way that TV shows, a staple of American entertainment for more than 50 years, are distributed and consumed.

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